HYBRID IC

VLA552-01R

DRIVER FOR IGBT MODULES

DESCRIPTION

VLA552-01R is a hybrid integrated circuit designed for driving n-channel IGBT modules in any gate-amplifier application. Electrical isolation voltage between input and output is 4000Vrms (for 1minute).This device include the isolated type DC-DC converter for a Gate drive. Therefore design of the gate power supply is not required.

The system of built-in short circuit protection provide a margin to time by function to maintain reverse bias for a predetermined time after the detection of short circuit.

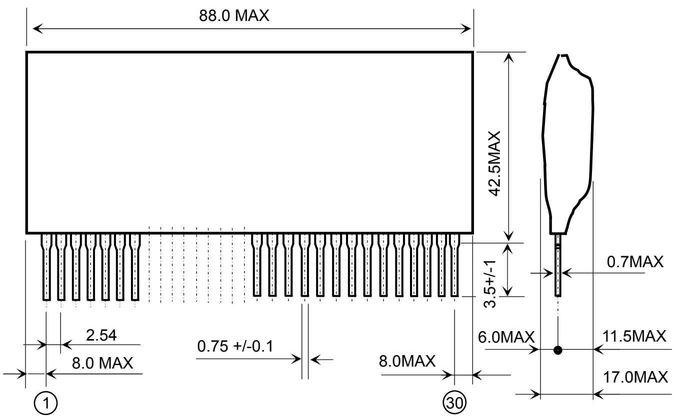
Recommended IGBT modules:

V_{CES} = 1200V series up to 3600A class

V_{CES} = 1700V series up to 3600A class

OUTLINE DRAWING

Dimensions : mm



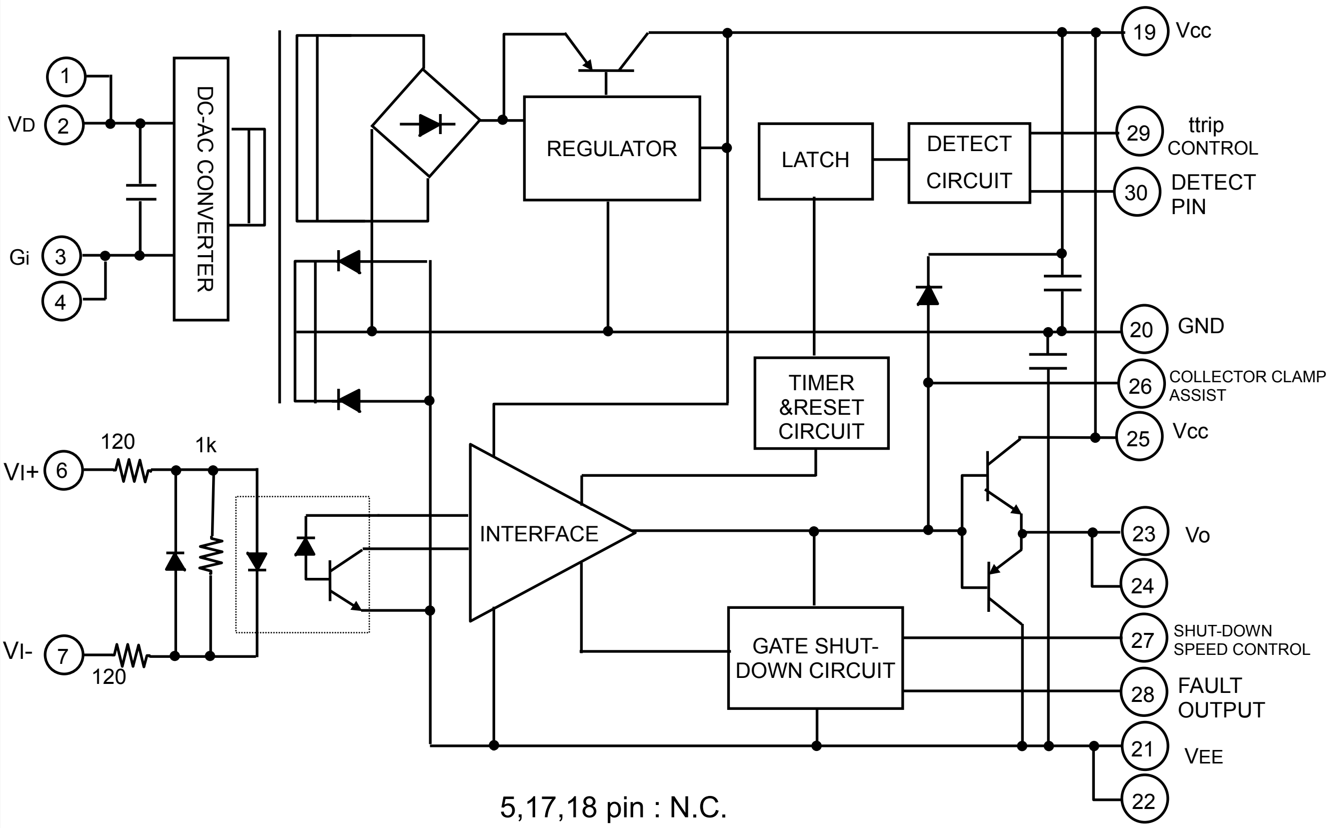
FEATURES

- •Built-in the isolated type DC-DC converter for gate drive
- •SIP outline allows more space on mother board
- •Built-in short circuit protection (With a pin for fault output)
- •Possible to assist collector clamp circuit
- •Variable fall time on activity of short circuit protection
- •Electrical isolation voltage between input and output is 4000Vrms (for 1minute)
- •CMOS compatible input.

APPLICATIONS

To drive IGBT modules for general industrial use apparatus.

BLOCK DIAGRAM



5,17,18 pin : N.C.

MAXIMUM RATINGS (Unless otherwise noted, Ta=25°C)

Symbol	Parameter	Conditions	Ratings	Unit
V_D	Supply voltage	DC	-1 ~ 16.5	V
V_I	Input signal voltage	Applied between pin 6 – 7 50% duty cycle, pulse width 1ms	-7 ~ +7	V
I_{OHP}	Output current	Pulse width 3μs	-24	A
I_{OLP}			24	A
Viso	Isolation voltage	Sine wave voltage 60Hz, for 1min. , R.H.<60%	4000	Vrms
T_C	Case temperature	Surface temperature	100	°C
Topr	Operating temperature	No condensation allowable	-25 ~ +70	°C
Tstg	Storage temperature	No condensation allowable	-40 ~ +100 (*1)	°C
I_{FO}	Fault output current	Applied pin 28	20	mA
V_{R30}	Input voltage to pin 30	Applied pin 30	60	V
I_{drive}	Gate drive current	Gate average current	210 (*2)	mA

(*1) Differs from H/C condition
(*2) Refer to Idrive-Ta CHARACTERISTICS.

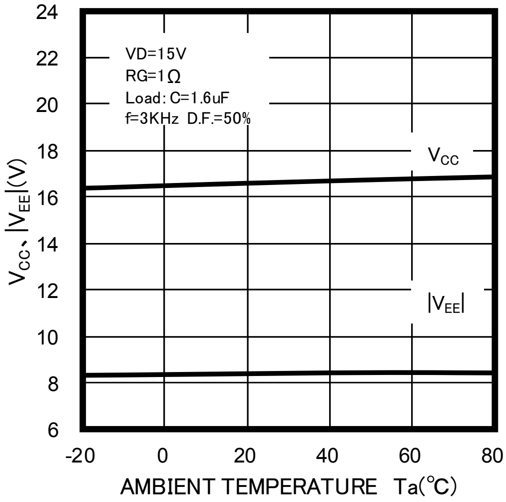
ELECTRICAL CHARACTERISTICS (Unless otherwise noted, Ta=25°C, V_D=15V, R_G=1 ohm, CL=1.6uF, f=3kHz)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_D	Supply voltage	Recommended range	14.2	15	15.8	V
V_{IN}	Pull-up voltage on input side	Recommended range	4.75	5	5.25	V
I_{IH}	Input signal current	Recommended range	10	12	16	mA
f	Switching frequency	Recommended range	-	-	10	kHz
R_G	Gate resistance	Recommended range	0.33	-	-	ohm
I_{IH}	Input signal current	V_{IN} = 5V HCMOS drive	-	12	-	mA
Vcc	Gate positive supply voltage	-	15.2	16.5	17.5	V
V_{EE}	Gate negative supply voltage	-	-6	-8	-11.5	V
η	Gate supply efficiency	Load current = 210mA η= (Vcc+|VEE |) x 0.21 / (15 x ID) x 100	60	72	-	%
V_{OH}	“H” output voltage	10k ohm connected between pin 23-20	14	15.3	16.5	V
V_{OL}	“L” output voltage	10k ohm connected between pin 23-20	-5.5	-7	-11	V
t_{PLH}	“L-H” propagation time	I_{IH} = 12mA	0.3	-	1	μs
t_r	“L-H” rise time	I_{IH} = 12mA	-	0.6	1.2	μs
t_{PHL}	“H-L” propagation time	I_{IH} = 12mA	0.3	-	1	μs
t_f	“H-L” fall time	I_{IH} = 12mA	-	0.3	1.2	μs
t_{timer}	Timer	Between start and cancel (under input sign “OFF”)	1	-	2	ms
I_{FO}	Fault output current	Applied pin 28, R = 4.7k ohm	-	5	-	mA
t_{trip1}	Controlled time detect short circuit 1	Pin 30 : 15V and more, pin 29 : open	-	3.5	-	μs
t_{trip2}	Controlled time detect short circuit 2 (*3)	Pin 30 : 15V and more, pin 29-21,22 : 10pF (connective capacitance)	-	3.9	-	μs
V_{SC}	SC detect voltage	Collector voltage of IGBT	15	-	-	V

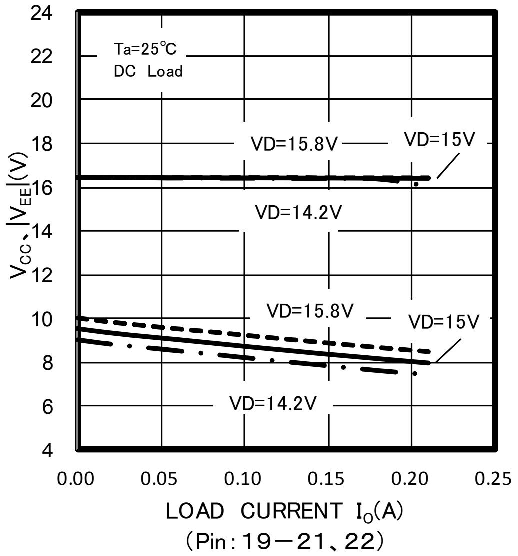
(*3) Length of wiring of condenser controlled time detect short-circuit is within 5cm from pin 21,22 and 29 coming and going.

PERFORMANCE CURVES

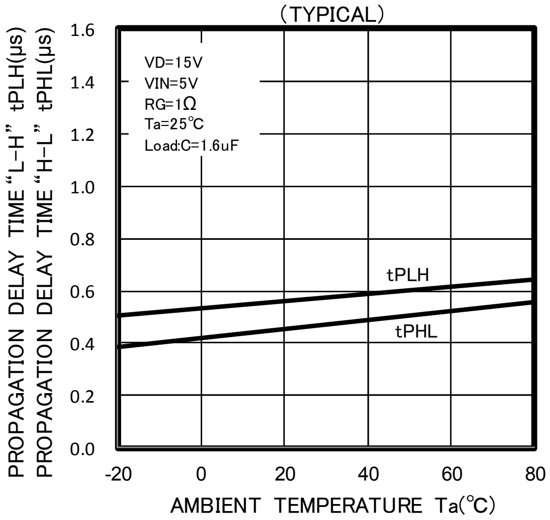
V_{CC}、$|V_{EE}|$−Ta CHARACTERISTICS
(TYPICAL)



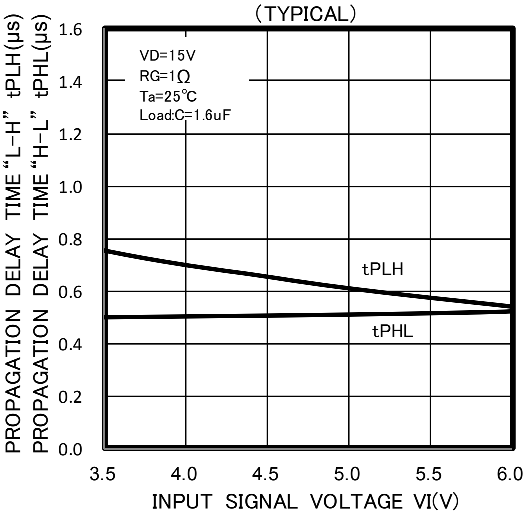
V_{CC},$|V_{EE}|$−I_O CHARACTERISTICS
(TYPICAL)



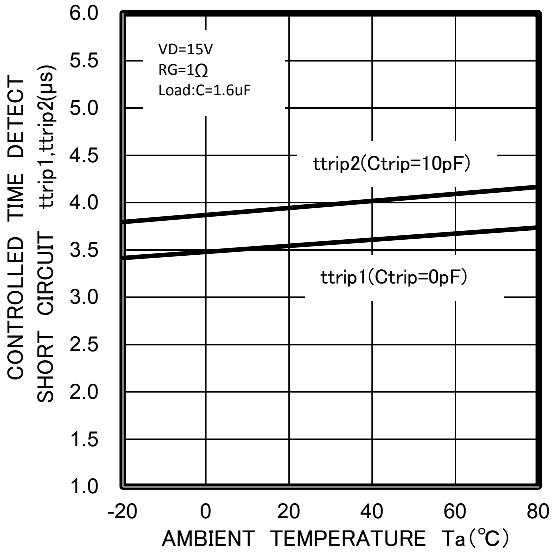
tPLH、tPHL−Ta CHARACTERISTICS
(TYPICAL)



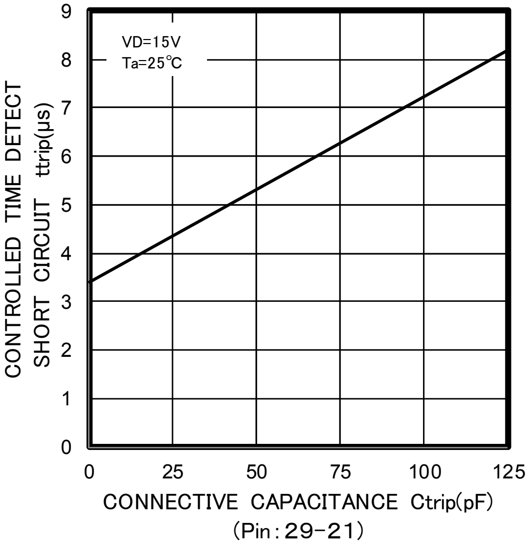
tPLH、tPHL−VI CHARACTERISTICS
(TYPICAL)



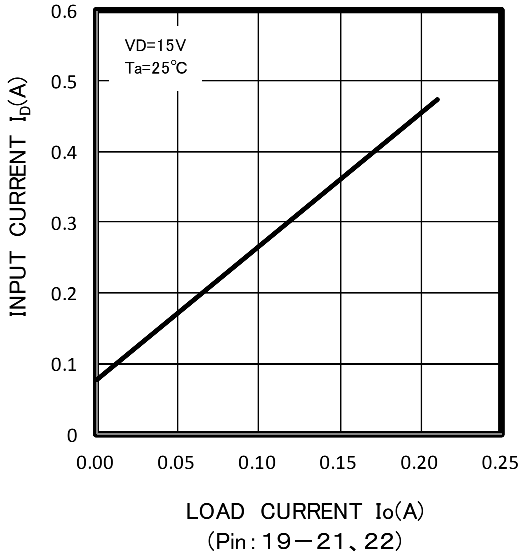
ttrip−Ta CHARACTERISTICS
(TYPICAL)



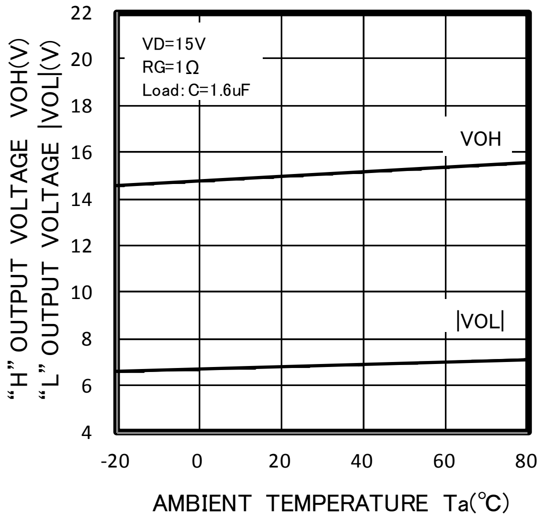
ttrip−Ctrip CHARACTERISTICS
(TYPICAL)



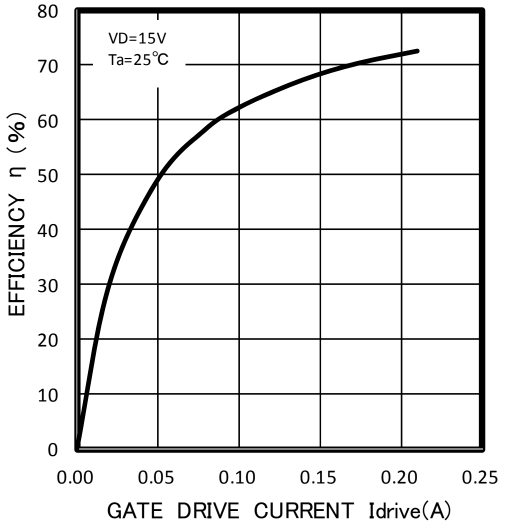
I_D–I_O CHARACTERISTICS
(TYPICAL)



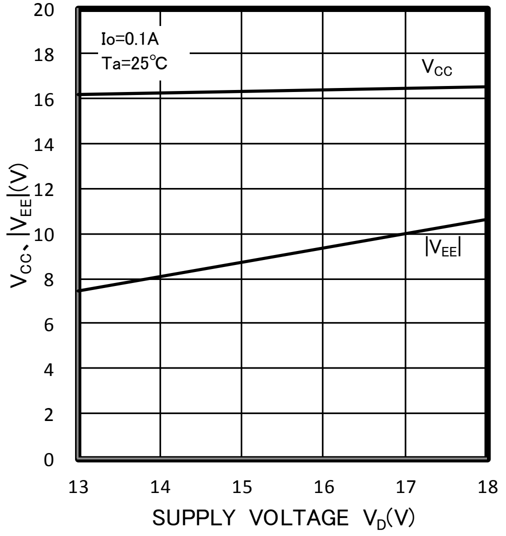
VOH,|VOL|–Ta CHARACTERISTICS
(TYPICAL)



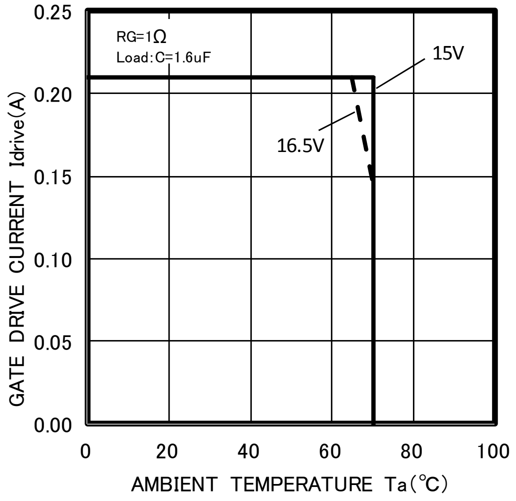
η-Idrive CHARACTERISTICS
(TYPICAL)



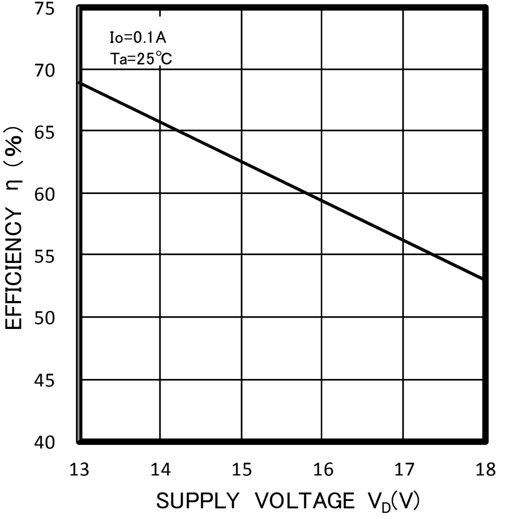
V_{CC}、$|V_{EE}|$–V_D CHARACTERISTICS
(TYPICAL)



Idrive–Ta CHARACTERISTICS
(MAXIMUM RATING)

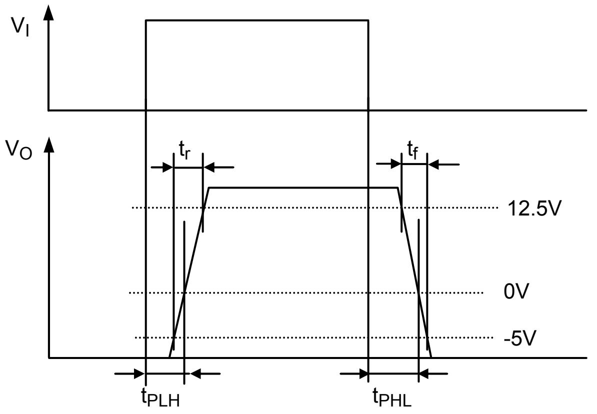


η–V_D CHARACTERISTICS
(TYPICAL)

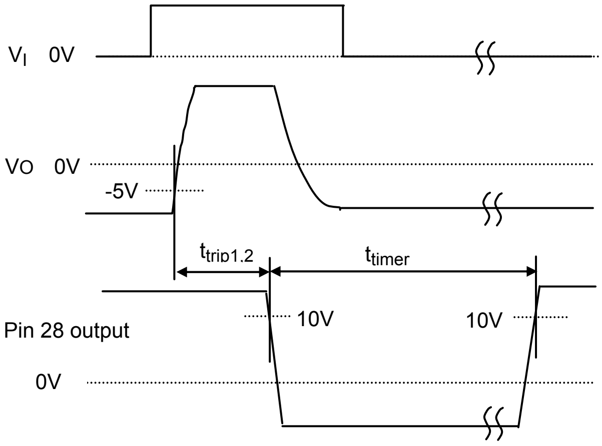


DEFINITION OF CHARACTERISTICS

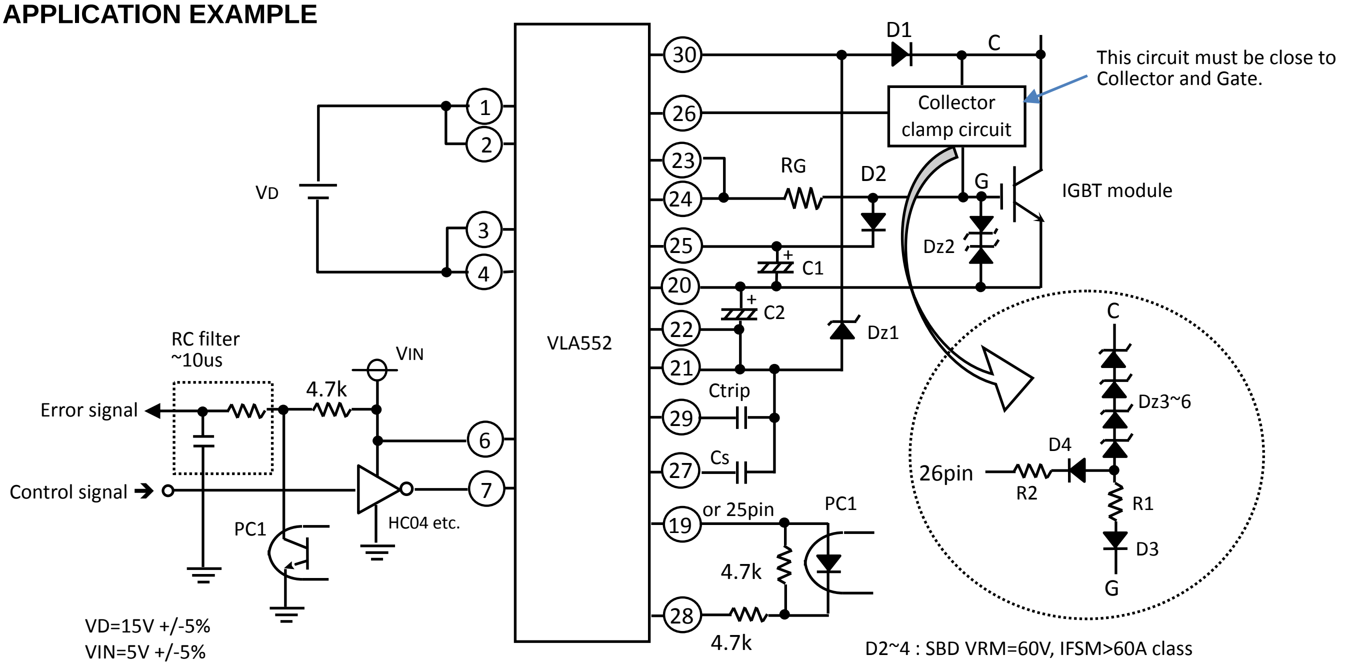
(1)SWITCHING OPERATION



(2)OPERATION OF SHORT CIRCUIT PROTECTION



APPLICATION EXAMPLE



VD=15V +/-5%
VIN=5V +/-5%
PC1 : TLP781 (TOSHIBA) etc.
Ctrip : Depend on RG
Cs : Depend on surge voltage
Dz1 : 30V, 0.5W~1W
Dz2 : 18V, Bidirectional
D1 : Fast recovery diode (trr : 200ns Max)
RP1H(SanKen) etc.
C1,C2 : 470uF, 35V(Low impedance)

D2~4 : SBD VRM=60V, IFSM>60A class
R1 : 1 ohm, 1W class
R2 : 10ohm,1/4W class
Dz3~6 : Vpn < Total Vz < VCES of IGBT
Rough guide of total Vz is as follows
For VCES 1200V series ➔ 900~1000V
For VCES 1700V series ➔ 1300~1400V
It depends on Vpn, IC(max), RG, snubber circuit, Inductance of power main circuit, and kind of main condenser.

PRECAUTION

(1) Voltage compensate capacitors are expected to be located as close as possible to the Hybrid IC.
(2) Minimize the area of closed circuit of gate circuit so as not to be affected by induction noise.
(3) D1 requires approximately the same voltage of IGBT modules.
(4) When recovery current flow in D1 , pin 30 is applied high voltage .
In that case , counterplan for protection which insert a zener diode between pin21 and 30 are necessary like above diagram.
(5) When you make late speed of reverse bias at the time of short circuit protection operation,
please adjust and connect a capacitor between pin 21 and 27.
(6) When the built in short-circuit protection circuit need not be used, please connect resistance of 4.7k ohm between pin 30 and 20.
(D1 and Dz1 are not required.)
(7) When the collector clamp circuit operates repeatedly, it may be destroied for heat. That is why the confirmation of calorific value is necessary for zener diode by actual inverter test.

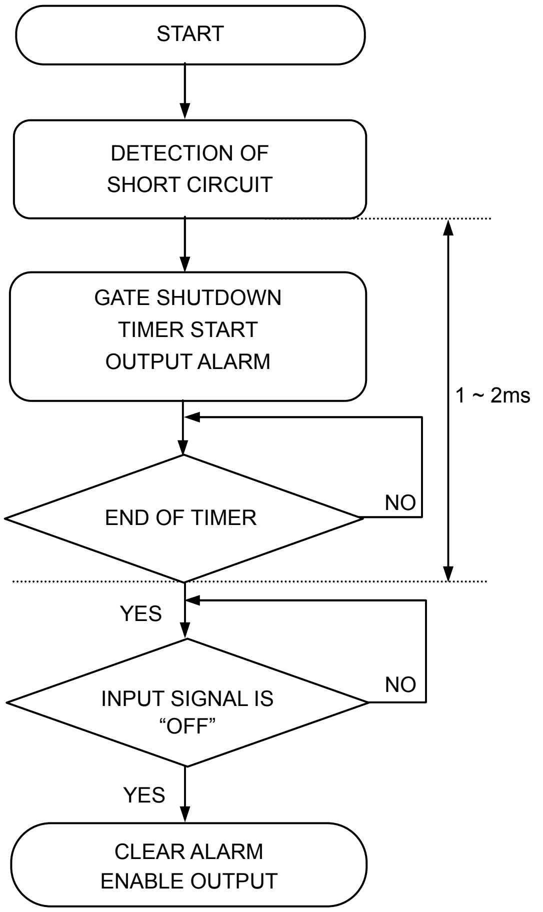
OPERATION OF PROTECTION CIRCUIT

(1) In case the gate voltage is “H” and the collector voltage is high, this Hybrid IC will recognize the circuit as short circuit and immediately reduce the gate voltage . Besides, put out a fault sign (“L”) which inform that protection circuit is operating at the same time from pin 28.

(2) The protection circuit reset and return to ordinary condition if input signal is “L” when the predetermined time(1 ~ 2ms) passed. (“L” period needs 15us or more)

(3) When the output rises, the controlled time detect short circuit (Typ 3.5us) is set up so that on-time of IGBT can be secured properly. It is possible to adjust that time by connecting the capacitor (Ctrip) between pin 21,22 and 29.

OPERATION FLOW ON DETECTING SHORT CIRCUIT



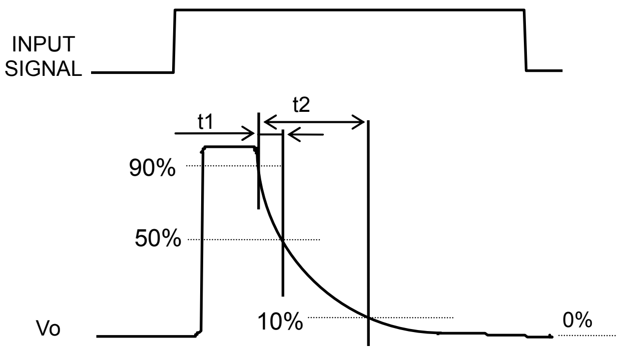
Note : Output voltage with protection circuit operating is about -lVEEl + 2V.

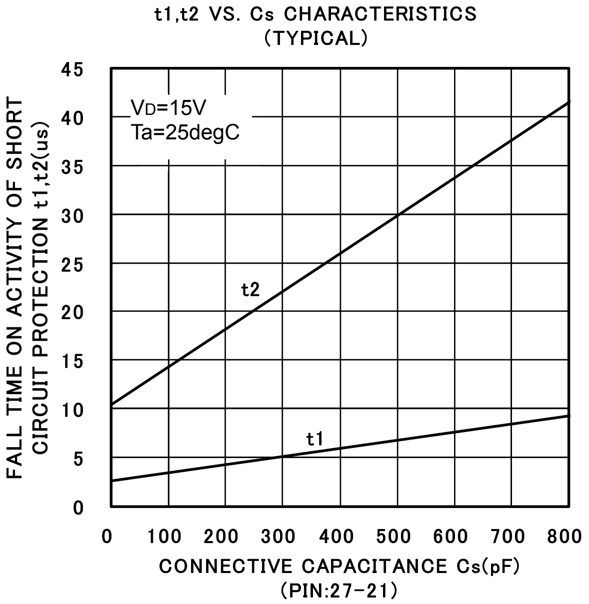
ADJUSTMENT OF OUTPUT FALL TIME

(When the protection circuit is operating)

In case you want to decrease the speed of reverse bias when the protection circuit is operating, you can adjust that speed by connecting the capacitor (Cs) between pin 21 and 27.

(Please refer to under figures.)

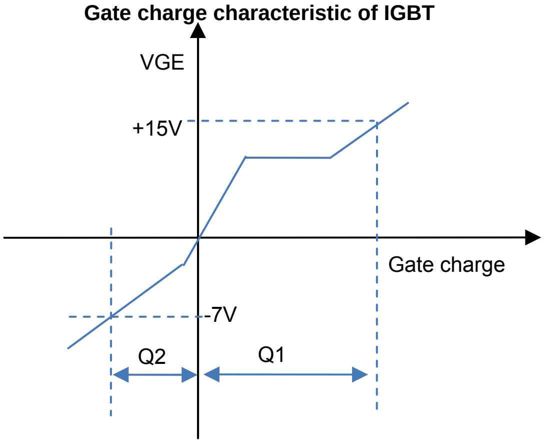




CAPACITY FOR POWER SUPPLY ON INPUT SIDE

This product has isolated DCDC converter built in for gate drive.
When you chose the power supply on input side,
please select the product that can supply the current capacity proven
by next 3steps.

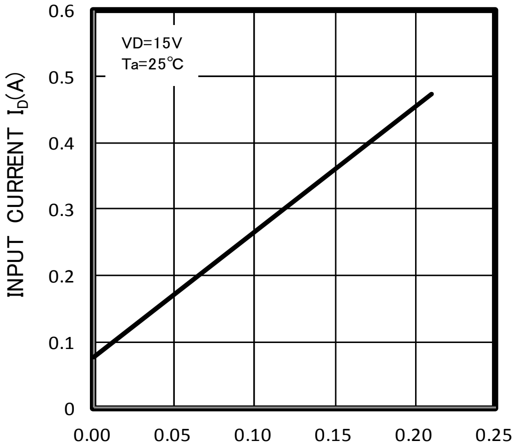
Gate charge characteristic of IGBT



1st step : Calculation for gate average current

Idrive = (Q1＋lQ2l) X f
Idrive : Gate average current
Q1 : Gate charge at +15V (Read from data sheet of IGBT)
Q2 : Gate charge at -7V (Read from data sheet of IGBT)
f : Switching frequency of IGBT

I_D-I_O CHARACTERISTICS
（TYPICAL）



LOAD CURRENT Io(A)
（Pin：19－21、22）

2nd step : Reading required current from performance curve

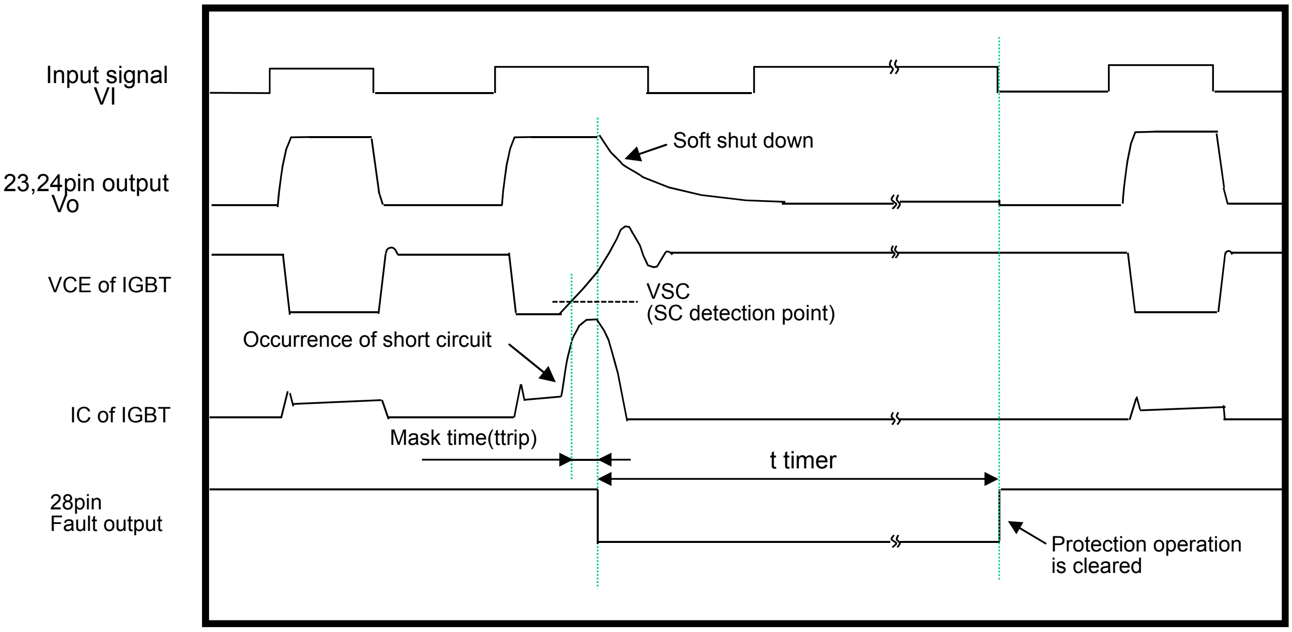
If the result of calculation for Idrive is 100mA
ID is about 270mA by right chart.
ID : Consumption current of DCDC converter in this HIC

3rd step : Securing the margin

Iout = ID x (1+ margin)
Iout : Output current of input power supply
Margin : 0.4

If the result of ID is 270mA, please prepare the power supply
that has the following spec.
Output voltage : 15V
Output current : more than350mA

TIMING CHART



FOR SAFETY USING

Great detail and careful attention are given to the production activity of Hics, such as the development, the quality of production, and in it’s reliability. However the reliability of Hics depends not only on their own factors but also in their condition of usage. When handling Hics, please note the following cautions.

CAUTIONS	
Packing	The materials used in packing Hics can only withstand normal external conditions. When exposed to outside shocks, rain and certain environmental contaminators, the packing materials will deteriorates. Please take care in handling.
Carrying	1) Don’t stack boxes too high. Avoid placing heavy materials on boxes. 2) Boxes must be positioned correctly during transportation to avoid breakage. 3) Don't throw or drop boxes. 4) Keep boxes dry. Avoid rain or snow. 5) Minimal vibration and shock during transportation is desirable.
Storage	When storing Hics, please observe the following notices or possible deterioration of their electrical characteristics, risk of solder ability, and external damage may occur. 1) Devices must be stored where fluctuation of temperature and humidity is minimal, and must not be exposed to direct sunlight. Store at the normal temperature of 5 to 30 degrees Celsius with humidity at 40 to 60%. 2) Avoid locations where corrosive gasses are generated or where much dust accumulates. 3) Storage cases must be static proof. 4) Avoid putting weight on boxes.
Extended storage	When extended storage is necessary, Hics must be kept non-processed. When using Hics which have been stored for more than one year or under severe conditions, be sure to check that the exterior is free from flaw and other damages.
Maximum ratings	To prevent any electrical damages, use Hics within the maximum ratings. The temperature, current, voltage, etc. must not exceed these conditions.
Polarity	To protect Hics from destruction and deterioration due to wrong insertion, make sure of polarity in inserting leads into the board holes, conforming to the external view for the terminal arrangement.

ISAHAYA ELECTRONICS CORPORATION

Keep safety first in your circuit designs!

- ISAHAYA Electronics Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (1) placement of substitutive, auxiliary circuits, (2) use of non-flammable material or (3) prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to our customers in the selection of the ISAHAYA products best suited to the customer’s application; they don't convey any license under any intellectual property rights, or any other rights, belonging to ISAHAYA or a third party.
- ISAHAYA Electronics Corporation assumes no responsibility for any damage, or infringement of any third party's rights, originating in the use of any product data, diagrams, charts or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams and charts, represent information on products at the time of publication of these materials, and are subject to change by ISAHAYA Electronics Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact ISAHAYA Electronics Corporation or an authorized ISAHAYA products distributor for the latest product information before purchasing product listed here in.
- ISAHAYA Electronics Corporation products are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact ISAHAYA Electronics Corporation or an authorized ISAHAYA products distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
- The prior written approval of ISAHAYA Electronics Corporation is necessary to reprint or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
  Any diversion or re-export contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact ISAHAYA Electronics Corporation or authorized ISAHAYA products distributor for further details on these materials or the products contained there in.